

Computing and Telecommunications Architecture Standards – Operating and Database Management Systems

Effective: June 30, 2001

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Introduction

These standards supercede and replace all previous standards relating to operating systems and database management systems. They also supercede and replace the Statements of Direction for Computing Architecture dated September 1990. Where applicable and existent, national standards from the American National Standards Institute (ANSI), the National Committee for Information Technology Standards (NCITS), the Federal Information Processing Standard (FIPS), the Institute of Electrical and Electronic Engineers (IEEE) and international standards from the International Standards Organization (ISO) have been adopted. For instances where formal standards do not exist, industry defacto standards are referenced.

In May 1988, the Information Services Board (ISB) adopted ten goals in a document entitled Strategic Directions for Information Technology (IT) in Washington State Government. In that document, the sixth strategic goal is to migrate to an integrated state computing architecture. An initial step toward the implementation of that goal was the development of the *Statements of Direction for Computing Architecture*. The statements document establishes the intent of the Information Services Board (ISB) to “move prospectively to a structured and standard computing environment.” The expected outcome was that: “A state computing architecture would help to ensure the state achieves maximum benefits from its investment in IT.” This direction and expectation was consistent with the overall “open systems architecture” movement of the early 1990s with an objective to “migrate to a computing environment that encourages connectivity, portability, scalability, and interoperability permitting an authorized computer user to access computer-based information resources anywhere in the state.”

The *Statements of Direction for Computing Architecture* recognized that “to be

meaningful and effective, computer architecture policies and standards must be periodically reviewed and updated.” There have been and will continue to be tremendous changes in Information Technology in the decade following this publication. First and foremost has been the migration from multi-tier processing model where much of the application code resides on the desktop (i.e., fat client) to an Internet/intranet access based model (i.e., thin client) that accesses server-based applications and data. Furthermore, vendors have created middleware or software that can allow applications on different systems to work together. These changes have outdated the statements document. However, the ISB intent and expected outcome from a standard computing architecture remains valid. Therefore, the Computing Architecture Standards – Operating Systems and Database Management Systems is being updated to continue to ensure that the state achieves maximum benefits from its investment in IT.

Statutory Authority

The provisions of RCW 43.105.041 detail the powers and duties of the ISB, including the authority to develop statewide or interagency information services and technical policies, standards, and procedures.

Scope

These standards apply to all executive and judicial branch agencies and educational institutions, as provided by law, that operate, manage, or use IT services or equipment to support critical state business functions.

Exemptions

None.

Standards

Operating System

The objectives of this operating system standard are to:

- Protect the investment in existing systems;
 - Encourage portability and scalability of computer application programs;
 - Encourage platforms that allow the availability of a wide range of existing applications;
 - Increase the transferability of staff skills;
 - Reduce the time required to port computer application programs to different vendor hardware and architectures;
 - Ensure operating system compatibility and interoperability, thus maximizing the return on investment in generating or purchasing computer programs; and
 - Minimize complexity by limiting the number of approved operating systems.

To attain the above objectives, the state of Washington adopts the following:

As adopted by the Washington State Information Services Board on September 27, 1990, and as updated herein, the standard architecture for host level computing is:

- S/390 Architecture and successor systems;
- Presumptively using the MVS and successor operating system and CICS teleprocessing monitor;
- For state government administrative information processing applications having large data and transaction volumes and requiring significant staff support.

This standard is not meant to imply that all processing must occur at the host level. Applications that provide operational support for major agency programs should reside on the appropriate processing level or combination of levels to meet state business needs.

As of September 1, 1991, purchases of new operating system products for administrative environments falling outside of the existing S/390/MVS standard must be only from the following choices:

- Windows (and evolutionary products), Windows NT (and evolutionary products)
- UNIX and UNIX variances based on IEEE standards

The VM operating system, while not listed as a standard product, is allowable when necessary to run more than one compliant operating system simultaneously on an S/390 platform. VM is not approved for use in applications development.

The Unisys operating system, EXEC 1100 and successor systems, while not listed as a standard product, is allowable to run legacy applications that have been developed using that platform or to make modifications to support changed requirements placed on legacy databases residing on that platform.

The Macintosh Operating System is an allowable client operating system for executive or administrative office applications, but not for large-scale applications development purposes.

In addition to the products named above, certified POSIX compliant products are acceptable. To be POSIX compliant, a vendor must obtain a Certificate of Validation from the [IEEE POSIX® Certification Authority](http://www.posix.org) (replaced National Institute of Standards and Technology as certification authority). Other acceptable evidence of POSIX compliance is "branding" or certification from the Open Group by demonstrating successful completion of the compliance tests.

A Validated Products List (formerly called the Validated Processor List) is posted on the Internet by IEEE at [List of IEEE POSIX® Validated Products](http://www.ieee.org/validated).

Agencies should, whenever possible, limit their purchases to vendors providing evidence of a corporate strategy to move toward POSIX compliance. POSIX is the Federal Information Processing Standard (FIPS) described in FIPS Publication 151-2 which has adopted ISO/IEC 9945-1: 1990 (IEEE Std. 1003.1: 1990) Information Technology-Portable Operating System Interface (POSIX)-Part 1: System Application: Program Interface (API) [C Language]. The state of Washington will continue to operate under these standards as they are revised and extended.

Primary and acceptable alternative operating systems by tier are summarized in Appendix A – Approved Operating Systems.

This standard applies to operating systems that are acquired for business use by state agencies.

Conformance to the standard shall be required whether the operating systems are:

- Acquired as part of an information system procurement; or
- Acquired as a stand-alone information technology procurement; or
- Used under an information technology licensing or leasing arrangement.

Solicitation documents must incorporate language requiring compliance with this standard from the effective date forward.

This standard will be updated as needed to reflect changes in technology, trends in the industry, and government strategy. The existing standard will be subject to periodic review. Stakeholders will be included in the process of developing, implementing, reviewing and revising the standard.

Middleware

Middleware is described many different ways but the *Techencyclopedia* definition seems to be as clear as any in suggesting the power of middleware and its essential nature in the Internet-browser age. It is as follows:

"Software that functions as a conversion or translation layer. It is also a consolidator and integrator. Custom programmed middleware solutions have been developed for decades to enable one application to communicate with another that either runs on a different platform or comes from a different vendor or both. Today there is a diverse group of products that offer middleware solutions."

That being said, there are no generally agreed standards for middleware. The software industry is developing new products to serve the need, but they have not subjected themselves to broadly agreed standards everyone can accept.

There is general industry consensus that middleware standards will emerge over time. Solutions to emerging needs are essential and will be sought in the interim. Therefore, the State of Washington has developed middleware guidelines to guide agencies in the deployment of middleware solutions. We will readdress middleware standards once industry or defacto standards emerge.

Database Management System

This standard recognizes that there are different types of database management systems (DBMS). For purposes of this standard, types of DBMS technology will be classified as:

- Hierarchical
- Relational
- Object-oriented
- Emerging

While the Structured Query Language (SQL) standard refers to relational databases, it does not recommend that relational be the only type of database considered when making database decisions. The standard also recognizes that emerging technologies will provide a requirement to periodically evaluate and update the standard. How this standard applies to these different types of DBMS is addressed in the sections on strategy and applicability.

The overall objective of this standard is to facilitate the sharing of data, promote the portability and scalability of database application programs, and improve transferability of programming staff and skills within and among state agencies.

The state of Washington computing environment is a diverse collection of hardware, operating systems, applications programs and languages, and database management systems. This standard expects to increase interoperability between and among databases through the use of a standard database access language or interface.

To attain the above objectives, the state of Washington adopts the following standard:

- Purchases of relational database products are limited to those products that comply with the Database Language SQL standards listed in Appendix B where applicable.

The state of Washington standard will incorporate subsequent evolutionary SQL standards adopted by the Federal government, when these standards are revised or superseded.

Hierarchical

Purchases of hierarchical database products will be limited to the installed base of DBMS products as of September 1991 that:

- Reside on established S/390 host level computing platforms (installed products as of that date are ADABAS and IMS), or
- Reside on other processors and currently support mission critical applications within state government.

Relational

This standard applies to all relational database applications developed or acquired by state agencies to support mission critical applications within state government. The standard is applicable to all computing platforms, including: personal computers; workstations; mini-computers (both departmental and stand-alone); database servers, and mainframes.

Data access using the SQL call structure is best suited for use in accessing relational databases and applications that use the relational data model. Further, the use of the standard SQL is strongly recommended for any database access when one or more of the following situations exist:

- The expected life of the database application is longer than the life of the current equipment or database management system, if any. There may be frequent changes to the database application or its specifications.
- The physical database is being designed and developed centrally for a decentralized system using different makes and models of computers or database software from a different vendor.
- It is expected that the database application may be run under a database management system other than the one for which it was initially written.
- Maintenance of the database application will be performed by programmers other than those who developed it.
- The data is likely to be used by other agencies or other governments.

There may be times when agency requirements can be met more economically and efficiently by the use of automatic program generators or by database access through a high-level language system. However, if the final output of the program generator or high-level language system will require access to a relational database, then the conditions and specifications of SQL are to be adhered to.

Object-Oriented

Applications that use object-oriented databases should comply with the ISO/IEC 14750:1999 Information technology – Open Distributed Processing – Interface Definition Language. The International Standards Organization adopted the standard for the Common Object Request Broker Architecture (CORBA) Interface Definition Language (IDL) from the Object Management Group (OMG). OMG is a private organization that controls the standard.

Emerging

Emerging database applications such as imaging, multimedia, hypertext, or scientific data collection are currently excluded from the applicability of this standard. To the extent that emerging technology products have SQL capability, SQL capable products are preferred over non-SQL capable products.

This standard applies to database management systems that are acquired for business use by state agencies.

Conformance to the standard shall be required whether the database management systems are:

- Acquired as part of an information system procurement; or
- Acquired as a stand-alone information technology procurement; or
- Used under an information technology licensing or leasing arrangement.

Solicitation documents must incorporate language requiring compliance with this standard from the effective date forward.

Other Considerations

Many vendors provide proprietary extensions to their product to differentiate it from the products of other vendors. The use of nonstandard features can make the interchange of programs or the replacement of a database management system more difficult and more costly. Nonstandard features should be used only when the needed operation or function cannot be reasonably implemented with the standard features.

Standards Exception Procedure

The architectural standards for information technology will be implemented over time through the state information technology planning, acquisition and feasibility study policies and processes. The Information Services Board delegates no agency authority for information technology acquisitions that deviate from the architectural standards.

Waivers

Any information technology acquisition that deviates from the architectural standards requires DIS review and approval. DIS will submit to the ISB for review, those acquisitions that both deviate from the architectural standard and have multiagency or statewide impact.

Requests for waivers must be:

- In writing;
- Signed by the top executive of the agency;
- Co-signed by the information technology manager; and
- Include a written business case justification.

Guiding principles to be used in the consideration of potential waivers include:

- Minimization of risk;
- Use of mainstream technology;
- Protection of investments in software and technical skills; and
- Improvement of connectivity.

Situations that may lead to waivers include:

- Federal restrictions when funding of the acquisition is predominantly federal;
- Legislative or regulatory mandates that require exceptional measures;
- The standard would preclude the ability to transfer a system from another organization;
- Upgrades to the installed base of existing systems.

However, waivers shall generally be granted only if:

- Compliance with the standard would adversely affect the ability of the agency to accomplish mission critical functions; or
- Compliance would cause a major adverse financial impact on the agency that is not offset by statewide savings.

Related Policies, Standards, and Guidelines

[Computing and Telecommunications Architecture Policy](#)

[Computing and Telecommunications Architecture Guidelines - Middleware](#)

Maintenance

Technological advances and changes in the business requirements of agencies will necessitate periodic revisions to policies, standards, and guidelines. The Department of Information Services is responsible for routine maintenance of these to keep them current. Major policy changes will require the approval of the ISB.

Appendix A – Approved Operating Systems

Introduction

Purchases of new operating system products for administrative environments must be only from the following choices under the specified conditions:

Operating System Tier	Primary	Acceptable Alternative	Acceptable Alternative
Host level	S/390 Architecture and successor systems	VM <ul style="list-style-type: none"> - Only when necessary to run more than one compliant system on a S/390 platform - Not approved for use in applications development 	Unisys EXEC 1100 and successor systems <ul style="list-style-type: none"> - Allowable to run legacy applications developed on this platform - Allowable to make modifications to support changed requirements placed on legacy databases residing on this platform
Server (Application Server, Internet Server, or Database Server)	UNIX and UNIX variances based on IEEE standards	Windows NT and evolutionary products	
Network (file and print)	Windows NT and evolutionary products	Netware	
Desktop	Windows, Windows NT and evolutionary products	Macintosh Operating System <ul style="list-style-type: none"> - Allowable for executive or administrative office applications - Not approved for large-scale applications development 	-

Appendix B – National Computing Architectural Standards

Introduction

The following pages cite international and national standards for the most effective processing of information technology. The tables and other references are presented in alphabetical order and cover:

- POSIX (Portable Operating System for UNIX)
- SQL (Structured Query Language)
- UNIX (A multi-user, multitasking operating system)

The **POSIX** standard defines an interface between programs and operating systems like UNIX. POSIX Standards are available from the Institute of Electrical and Electronics Engineers reachable by the Internet at <http://standards.ieee.org/catalog/sol/index.html>
Note the following tables of standards hyperlink directly to the source for documents.

POSIX STANDARDS

Document Number	Document Title
ISO/IEC ISP 15287-2:2000	Information technology - Standardized Application Environment Profile - Part 2: POSIX(r) Realtime Application Support (AEP)
ISO/IEC 9945-2:1993	Information technology - Portable Operating System Interface (POSIX) - Part 2: Shell and Utilities
IEEE 2003.1b-2000	Standard for Information Technology - Test Methods Specifications for Measuring Conformance to POSIX - Part 1: System Application Program Interface (API) - Amendment 1: Realtime Extension [C Language] (supplement to ANSI/IEEE 2003.1-1993)

2003.1-1992	IEEE Standard for Information Technology Test Methods for Measuring Conformance to POSIXA(r)Part1: System Interfaces
1003.9-1992	IEEE Standard for Information Technology - POSIXA(r) FORTRAN 77 Language Interfaces - Part 1: Binding for System Application Program Interface (API)
1003.5-1999	IEEE Standard for Information Technology--POSIX & Ada Language Interfaces--Part 1: Binding for System Application Program Interface (API)--Amendment 2: Protocol - Independent Interfaces

SQL is an ANSI (American National Standards Institute) Standard. ANSI also cooperates with others in Standard development like NCITS (National Committee for Information Technology Standards) and ISO (International Standards Organization) and jointly publishes such standards that are internationally accepted. ANSI standards can be acquired by the Internet at <http://webstore.ansi.org/ansidocstore/default.asp>

SQL STANDARDS

ANSI X3.135- 1992 (R1998)	Information Systems – Database Language – SQL (includes ANSI X3.168-1989) THE ADOPTION OF ISO/IEC 9075-1, -2, -4 AND -5 WILL RESULT IN THE SUBSEQUENT WITHDRAWAL OF X3.135:1992
ANSI/ISO/IE C 9075-5- 1999	Information Technology - Database Languages - SQL - Part 5: Host Language Bindings (SQL/Bindings)
ANSI/ISO/IE C 9075-4- 2003	Information Technology - Database languages - SQL - Part 4: Persistent Stored Modules (SQL/PSM)
ANSI/ISO/IE C 9075-3- 2003	Information Technology - Database Languages - SQL - Part 3: Call-level Interface (SQL/CLI)
ANSI/ISO/IE C 9075-2- 2003	Information Technology - Database languages - SQL - Part 2: Foundation (SQL/Foundation)

ANSI/ISO/IE C 9075-1- 2003	Information Technology - Database Language - SQL Part 1: Framework (SQL/Framework)
ANSI/ISO/IE C 9579:2000	Information Technology – Remote Database Access – for SQL with security enhancement

UNIX, is a non-vendor specific multi-user, multitasking operating system. A standard is now being developed by the Open Group, a private organization committed to open systems. They are in the process of having their standard for UNIX considered for adoption by IEEE as the national standard for non-vendor-based software. They expect joint adoption in June. Open Group can be accessed through the Internet at <http://www.opengroup.org/>